

REMARKS/ARGUMENTS

Claims 1-26 were previously pending in the application. Claim 26 is canceled; claims 1-25 are amended; and new claims 27-28 are added herein. Assuming the entry of this amendment, claims 1-25 and 27-28 are now pending in the application. The Applicant hereby requests further examination and reconsideration of the application in view of the foregoing amendments and these remarks.

Specification

In paragraph 1 of the office action, the Examiner requested update of the status of the related application mentioned throughout the specification. In response, the Applicant has amended the specification accordingly.

Claim Objections

In paragraph 2, the Examiner objected to claims 1-14 and 16-26 because of certain informalities.

Regarding the objection to claims 1 and 2, the Applicant has amended claims 1 and 15 to expand CIR and claim 2 to expand OFDM.

Regarding the objection to claims 3-14 and 16-25, the Applicant has amended claims 2-14 and 16-25 to recite "method" and "receiver," respectively, instead of "invention."

Regarding the objection of claims 10, 11, and 13, claim 1 has been amended to recite that "the receiver comprises a plurality of receiver antennas."

Regarding the objection of claim 21, the Applicant submits that, according to claim 15, the receiver comprises a plurality of receiver antennas, where a plurality of channels are used by at least one receiver branch to determine its symbol timing. According to currently amended claim 21, the plurality of channels used by the at least one receiver branch corresponds to a single antenna of the receiver. Claim 21 is silent about whether or not any channels corresponding to other antennas of the receiver are used by any other receiver branches to determine their symbol timing. As such, the subject matter of claim 21 covers all such possibilities, including the possibility that no other receiver branches use any channels corresponding to any other antennas to determine their symbol timing.

Regarding the objection to claim 26, since claim 26 has been cancelled, the objection to that claim is moot.

In view of the foregoing, the Applicant submits that the claim objections have been overcome.

Claim Rejections - 35 USC 112

In paragraph 4, the Examiner rejected claims 3, 4, and 16 under 35 U.S.C. 112, second paragraph, as being indefinite. In response, the Applicant submits that the amendments made to claims 1 and 15 provide antecedent basis for "the CIR" in claims 3 and 16.

In paragraph 7, the Examiner rejected claim 26 under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The Applicant disagrees with the Examiner's conclusion that original claim 26 is not enabled. Nevertheless, since claim 26 has been canceled, the rejection of claim 26 under 35 U.S.C. 112, first paragraph, is moot.

In view of the foregoing, the Applicant submits that the claim rejections based on 35 U.S.C. 112 have been overcome.

Claim Rejections - 35 USC 103 and Allowable Subject Matter

In paragraph 9, the Examiner rejected claims 1, 3, 5-7, 9-10, 12-13, 15, 17-19, 21-22, 24, and 26 under 35 U.S.C. 103(a) as being unpatentable over Sehier in view of Alamouti. In paragraph 10, the Examiner rejected claim 2 under 35 U.S.C. 103(a) as being unpatentable over Sehier in view of Alamouti and further in view of Li. In paragraph 11, the Examiner rejected claims 8 and 20 under 35 U.S.C. 103(a) as being unpatentable over Sehier in view of Alamouti and further in view of Schmidl. In paragraph 12, the Examiner rejected claims 4 and 16 under 35 U.S.C. 103(a) as being unpatentable over Sehier in view of Alamouti and further in view of Kobylinski. In paragraph 13, the Examiner objected to claims 11, 14, 23, and 25 as being dependent upon a rejected base claim, but indicated that those claims would be allowable if rewritten in independent form. For the following reasons, the Applicant submits that all of the now-pending claims are allowable over the cited references.

Claims 1 and 15

According to currently amended claim 1, a receiver of a MIMO system receives signals from a plurality of transmitter antennas, where each transmitter antenna transmits multiple channels. For each of a plurality of channels originating from the transmit antennas, the receiver estimates a CIR value characterizing channel impulse response (CIR) of the channel. The receiver sums the CIR values for the plurality of channels to generate a plurality of summed CIR values and integrates the summed CIR values over a specified window to generate an integrated summed CIR value. The receiver determines symbol timing in the received signals based on the integrated summed CIR value and processes the received signals based on the determined symbol timing.

In rejecting claim 1, the Examiner admitted that "Sehier does not teach that the signals are received from a plurality of transmitter antenna." Instead, the Examiner cited Alamouti as disclosing "a receiver for receiving a plurality of signals from a plurality of transmitter antenna." According to the Examiner, "it would have been obvious to one skilled in the art to incorporate such a teaching in Sehier et al so as to be able to process signals from systems that use STTD encoding technique that generally employs at least two transmitting antennas."

First of all, the Examiner does not explain what an "STTD encoding technique" is. The Applicant was not able to find any reference to an STTD encoding technique in either Sehier or Alamouti. As such, the Applicant does not understand how an STTD encoding technique can make the combination of teachings in Sehier and Alamouti obvious.

Furthermore, the teachings in Sehier are directed to a communications scenario in which a transmitter transmits a single channel, and the receiver receives a plurality of diversity channels corresponding to different transmission paths for that single transmitted channel. See, e.g., column 1, lines 11-22, and column 2, lines 56-63. While it is true that Alamouti teaches a transmitter having multiple transmit antennas and a receiver having multiple receive antennas, the Applicant submits that it is not obvious to apply the timing recovery technique taught in Sehier, which is designed for a communications scenario in which a single channel is transmitted from a single transmit antenna, to the communications scenario having multiple transmit antennas as taught in Alamouti to provide the present invention in which each different transmit antenna of a plurality of transmit antennas transmits multiple channels and each different receive antenna of a plurality of receiver antennas receives multiple channels.

from each of the transmit antennas. Simply stating something about an undefined "STTD encoding technique" is insufficient for providing motivation for a combination of such different teachings.

For all these reasons, the Applicant submits that claim 1 is allowable over the cited references. For similar reasons, the Applicant submits that claim 15 is allowable over the cited references.

Since claims 2-14 depend directly or indirectly from claim 1 and claims 16-25 depend directly or indirectly from claim 15, it is further submitted that those claims are also allowable over the cited references.

Claims 7 and 19

According to currently amended claim 7, a plurality of integrated summed CIR values are generated corresponding to a plurality of different instances of the specified window, each instance corresponding to integrating a different set of summed CIR values for the plurality of channels, and the determined symbol timing is based on selecting a maximum integrated summed CIR value of the plurality of integrated summed CIR values.

In rejecting original claim 7, the Examiner stated that determining symbol timing based on a maximum of the integrated summed CIR values would have been obvious "in order to ensure that only positive values are generated so as to simplify circuit layout." The Applicant submits that the Examiner's rejection of original claim 7 was based on a misinterpretation of the subject matter of claim 7. Claim 7 has been amended to clarify that a plurality of different integrated summed CIR values are generated and that the integrated summed CIR value having the maximum value is selected for use in determining the symbol timing.

The cited references do not teach or even suggest such a combination of features. As such, the Applicant submits that this provides additional reasons for currently amended claim 7 and similarly for currently amended claim 19 over the cited references.

Note that, in claims 7 and 19, two sets of summed CIR values may still be "different" even if they have one or more summed CIR values in common, so long as they do not have all of their summed CIR values in common. Of course, two sets having no summed CIR values in common will also be "different."

Claims 13 and 24

According to currently amended claim 13, the single, joint symbol timing is determined for all of the receiver antennas by:

- o Estimating the CIR value for each of the plurality of channels corresponding to all of the antennas of the receiver;
- o Summing the CIR values for the plurality of channels corresponding to all of the antennas of the receiver to generate the plurality of summed CIR values;
- o Integrating the summed CIR values over a specified window to generate the integrated summed CIR value; and

- o Determining the single, joint symbol timing in the received signals based on the integrated summed CIR value.

In rejecting original claim 13, the Examiner stated that Sehier teaches "a joint timing is determined at the output of circuit 29 for all receiver antennas." While it is true that Sehier teaches the determination of a clock signal corresponding to a single recovered symbol timing rate ($1/T$), that timing rate is derived based on the results of independent performance of channel estimation for each different diversity channel. Fig. 1 shows multiple instances of channel estimator 23 with a different channel estimator for each different diversity channel. See column 4, lines 30-32 ("a plurality of channel estimator circuits 23 each equipping one diversity channel"). To the extent that, according to the Examiner's argument, the output of each channel estimator circuit 23 is equivalent to an integrated summed CIR value, each channel estimator circuit 23 independently generates its own integrated summed CIR value and multiple such integrated summed CIR values are applied to timing estimator circuit 25.

According to currently amended claim 13, however, a single, joint symbol timing is derived by processing all of the channels received at all of the receiver antennas together to generate a single integrated summed CIR value. Sehier does not teach or even suggest such a feature. As such, the Applicant submits that this provides additional reasons for currently amended claim 13 and similarly for currently amended claim 24 over the cited references.

New Claims 27-28

Support for new claim 27 is found in original claims 1 and 9-11. For similar reasons that the Examiner indicated that original claim 11 was directed to allowable subject matter, the Applicant submits that new claim 27 is allowable.

Support for new claim 28 is found in original claims 1 and 14. For similar reasons that the Examiner indicated that original claim 14 was directed to allowable subject matter, the Applicant submits that new claim 28 is allowable.


Conclusion

For the reasons set forth above, the Applicant respectfully submits that the rejections of claims 1-10, 12-13, 15-22, and 24 under Section 103(a) have been overcome. Furthermore, new claims 27-28 patentably define over the cited references.

In view of the above amendments and remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

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